

## Renewable Diesel Fuels Research at Argonne

### Overview

Reducing the dependence on foreign oil and rising crude oil costs are primary reasons for a renewed interest in renewable fuels for the transportation sector. Public concern of mobile sources of air pollution and stringent emissions regulations provide additional incentives to produce fuels that generate fewer emissions, potentially reducing the need for sophisticated, expensive exhaust after-treatment devices.

### The Advantages of Diesel

Diesel engines provide improved fuel conversion efficiency, greater torque over a wider engine operating speed (improved acceleration), and potentially lower emissions compared to gasoline engines, making them an attractive power source for future passenger car vehicles. Current fuel injection and controls technology have actively addressed the black smoke and noise issues previously associated with diesel engines. With the addition of a renewable fuel, the diesel engine can help address the issues of foreign oil dependence and greenhouse gas emissions in one, compact solution.

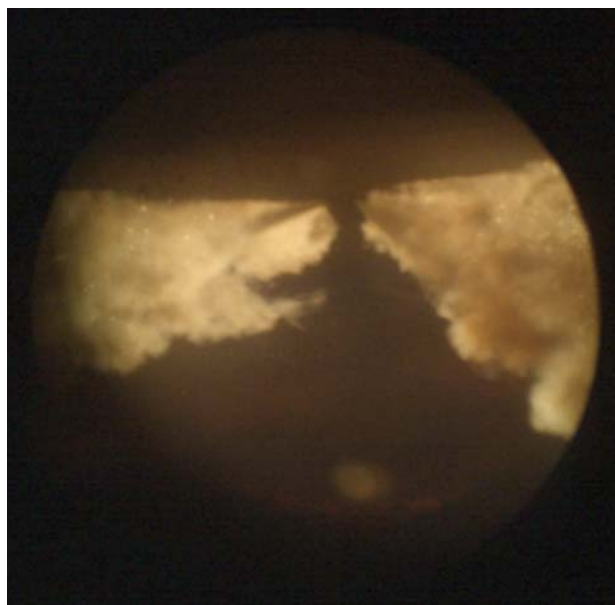
### Research Focus

Renewable diesel fuels are commonly grouped into two categories. Biodiesel, a fatty acid methyl ester, is commonly produced from soybean, yellow grease, or other sources of triglyceride through the transesterification process. Synthetic diesel fuel, typically produced from cellulosic sources (wood, plant, biomass material) is usually produced using the Fischer-Tropsch process. Biodiesel is typically less expensive to manufacture and requires less energy input to produce compared to synthetic diesel fuel. It contains almost no sulfur or aromatics, but does contain oxygen and typically has a higher viscosity than petroleum diesel. Synthetic diesel fuel is more energy intensive to produce but has a higher cetane number, lower viscosity and contains no oxygen. Both categories of renewable diesel fuels present advantages and disadvantages.

### Technical Approach and Tools

Argonne researchers utilize several advanced combustion and engine diagnostic tools to characterize the effect of fuel properties on the

operational quality of the engines. One such tool is a combustion visualization system that allows the real-time capture of combustion events inside the engine's combustion chamber. These images provide the engineers with information on soot formation (creation) and oxidation (destruction) rates inside the combustion chamber, as well as the locations of highest soot concentration and even an estimate of peak combustion temperature, which has been shown to correlate with NO<sub>x</sub> production.



*A sample diesel combustion image, taken during actual engine operation at 2500 rpm and 75 ft-lbs of load!*

It is the goal of the Argonne research team to maximize the benefits of renewable diesel fuels while minimizing the implementation and economic impact to manufacturers and consumers.

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